## DETAILED ACTION

1. This is a Non-final office action following the filing of a Request for Continuation (RCE). Claims 7-21 are pending.

### *Continued Examination Under 37 CFR 1.114*

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/14/2011 has been entered.

### *Response to Amendment*

3. Claims 7-21 are as previously presented.

### *Response to Arguments*

4. Applicant's arguments filed 11/14/2011 have been fully considered but they are not fully persuasive as follows:

Applicant's arguments with respect to the rejection under 35 U.S.C. 103(a) over Duncan (US Pat. No. 7,290,589) in view of Guessasma have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground of rejection is made below.

## *Claim Rejections - 35 USC § 103*

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 7-21 rejected under 35 U.S.C. 103(a) as being unpatentable Guessasma et al. ("Neural Computation to Predict In-Flight Particle Characteristic Dependences from Processing Parameters in the APS Process", Journal of Thermal Spraying Technology, Dec. 2004) in view of Swank et al. ("A Particle Temperature Sensor for Monitoring and Control of the Thermal Spray Process", Sept. 1995) and further in view of Sandhu et al. ("Design of a Neuro Fuzzy Controller", IEEE, 1997).

Claim 7

Guessasma et al. teaches **a method for coating a workpiece** (see Abstract)**,** for a process including **applying a material to the workpiece by a thermal spray coating process** (see Introduction)**.** Guessasma et al. further teaches employing a neural network to determine "ideal" processing parameters by training a four-layer perceptron (neural network) using measured in-flight particle characteristics, predicting those processing parameters which, if controlled by conventional feedback control system using sensors to monitor fluctuations in the plasma jet, would thereby achieve high quality thermal spray coatings (see Fig. 1, pg. 571; Section 2. In-flight Particle Characteristics Measurement, pg. 572). However, Guessasma et al. does not expressly teach:

**monitoring the thermal spray coating process by detecting an actual value of a property of a particle in a spray jet of the thermal spray coating process;**

**comparing the actual value with a target value for the property; and**

**automatically adjusting a process parameter for the thermal spray coating process when there is a deviation between the actual value and the target value for the property;** nor does Guessasma expressly teach

automatically adjusting **by a neuro-fuzzy regulator … based on a neuronal network with fuzzy logic rules, wherein the neuronal network maps a relationship between an input variable and an output variable of the neuro-fuzzy regulator.**

Swank teaches on-line control of thermal spray coating process by monitoring properties of in-flight particles using conventional feedback control (see Abstract; Conclusions, pg. 5). Conventional feedback control systems employ an output (an actual measured value) which is driven to a target (reference) value by a control adjustment using the error (a deviation) between the actual value and the target value. This feedback control concept is well-known in the art of control theory as well as known to be applied specifically to thermal spray coating processes as in Swank. (See also Moreau et al. cited herewith as an authority in the art of online control of plasma spraying processes using feedback control from in-flight particle measurements.) That Guessasma provides ideal process parameters for such, it would have been obvious to one of ordinary skill in the art at the time of the invention to employ Swank (or any number of variations of convention online control) to hold or attempt to hold process parameters to their desired “predicted” values to achieve the best quality coating output.

As to a *neuro-fuzzy regulator***,** Guessasma teaches using a neural network trained by mapping input and output sets on experimental data using the in-flight particle property measurements to predict process parameters of an ideal thermal spraying process. The output of the neural network determines the process parameter targets for optimal quality control of the process. However, while Guessasma suggests the purpose of the neural network is for control of a thermal spray coating process (see Abstract), Guessama does not expressly teach *actual* control of the thermal spraying or control of the process *by a neural fuzzy regulator*.

The present invention uses a "neuro-fuzzy regulator," disclosed as a neural network which is trained on experimental data using in-flight particle property measurements to derive "pre-determined target" parameters of a thermal spraying process (see specification [0007, 0021-0024, and 0032]). Similar to Guessasma, the so-called "neuro-fuzzy regulator" determines the pre-determined target parameters to be controlled during thermal spraying. However, while the present invention as claimed recites *actual* control of thermal spraying process and *appears* at first reading to recite actual control by a neural fuzzy regulator (i.e. the neural fuzzy regulator as a controller in the feedback loop of actual control), the invention does not *disclose* direct employ of the neuro-fuzzy regulator as a *controller* in the actual control process. Broadly interpreting the limitation *by a neuro-fuzzy regulator* in light of the specification and in comparison to Guessasma, the present invention also finds predicted (target) process parameters related to the measured in-flight particular properties from training sets known to result in optimal or near-optimal thermal spraying results.

Notwithstanding the above, Sandhu et al. in the general art of intelligent control of industrial processes (see Sandhu, Introduction) teaches combining fuzzy logic into the design of a neural network, thereby inserting into a neural network layer “fuzzy logic control rules” (see Introduction, 3rd paragraph, pg. 3170, right column; and Figure 1, pg. 3171). Sandhu et al. motivates the use of such a *neuro-fuzzy controller* in that such systems remain "highly transparent and easily interpretable" an improvement over "black box" neural networks in other industrial controls.

Given Sandhu et al. in view of the need for precise control in the thermal spray coating process of Guessasma, it would have been obvious to one of ordinary skill in the art to improve Guessasma by employing a *neuro-fuzzy controller* (i.e. regulator) as a substitution for the conventional control suggested by Guessasma and implemented by Swank. One of ordinary skill would merely have applied Sandhu et al. by extending Guessasma’s neural network from process parameter training to actual control using the same off-line training sets in the training of the neural-fuzzy controller (see Sandhu, pg. 3173, Section 5), then employing Sandhu’s neuro-fuzzy controller to maintain the process parameters at the desired target values. Applying a known technique to known device, method, or product that is ready for improvement is obvious if the particular known technique was recognized as part of the ordinary capabilities of one skilled in the art, who would have been capable of applying this known technique to the known device, method, or product, and the results would have been predictable to one of ordinary skill in the art. *KSR International Co. v.Teleflex Inc. (KSR), 550 U.S. ___, 82 USPQ2d 1385 (2007).* MPEP ¶ 2141 [R-6].

Claim 8-13

Guessasma et al. teaches or suggests **the method according to Claim 7, wherein the step of comparing the actual value with the target value for the property includes deriving a characteristic quantity for the property from the actual value and comparing the characteristic quantity with the target value** (as above, from the basis of conventional control or control by feedback, comparing "characteristic quantities" or measurements of properties to target or desired or ideal values)**; wherein the thermal spray coating process is a plasma spray process** (see Introduction).

Guessasma et al. teaches the criticality of temperature and size of particles in thermal spray processes and thus suggests controlling parameters of **particle temperature, velocity, size** or **luminous intensity** (pg. 577, Section 4.2, 4.4)**.**

Claims 14-16

Guessasma et al. teaches or suggests **the method according to Claim 7,** including the use of **a layered artificial neuronal network (ANN)** (Fig. 2); **wherein the neuronal network comprises at least four layers each having multiple neurons** (see Figure A1, pg. 583)**, wherein the neurons of an input layer map a fuzzification, the neurons of an output layer map a defuzzification, and the neurons of the layers arranged between the input layer and the output layer map a fuzzy inference** (see discussion of a neuro fuzzy controller in Sandhu et al. combined as explained above for claim 7)**.**

Similarly, as to claims 15 and 16, the passing of inputs to outputs in a neural network is a **mapping a relationship… processing… and converting… to an output variable**; and **processing…** by an ANN is processing in a neural-fuzzy controller (as above) **by linguistic rules and fuzzy operators, wherein the step of processing the fuzzy variable by the second layer of the neuronal network includes the step of processing by linguistic rules and fuzzy operators** (Sandhu et al., Figure 1, pg. 3171)**.**

Claims 17-21 recite apparatus for performing the methods of claims 7-16 as above, and are similarly rejected for reasons given above, for the respective claim and claim elements, and further that Guessasma et al. teaches apparatus for the performing, including **a camera**, **and an image processing system**; and **wherein an actual value of a property of a particle in the spray jet is determined by the image processing system from an image of the spray jet obtained from the camera** (see Fig. 1 pg. 571)**.**

## ***Conclusion***

7. The prior art made of record and listed on the attached PTO Form 892 but not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dave Robertson whose telephone number is (571)272-8220. The examiner can normally be reached on Weekdays M-F 7:15am to 3:45 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Albert Decady can be reached on (571) 272-3819. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/Dave Robertson/
Primary Examiner, Art Unit 2121